agricultural research

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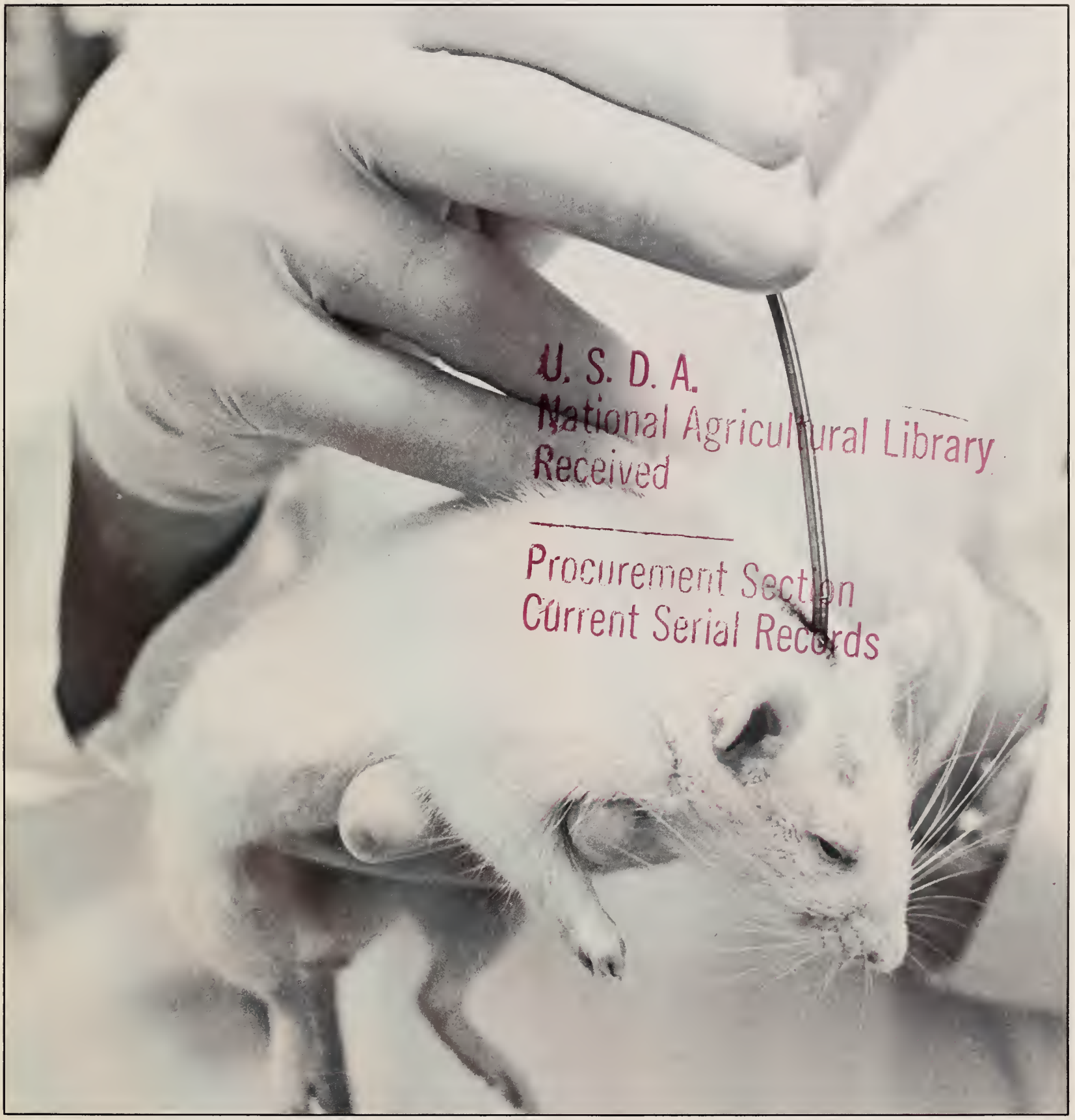

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Atomic Sleuths

Atoms work hard for agriculture. Radioactive isotopes—serving as tracers—are unlocking a wealth of knowledge about soils, plants, and animals. Like tiny radio stations, these atomic tracers beam steady waves that signal the location and movement of the radioactive atoms. An array of radiation-detecting instruments enable scientists to readily follow their motion, both through inert laboratory experiments and living organisms.

Although radioactive isotopes were not widely available for research purposes until after World War II, almost 70 years ago a USDA scientist, W. H. Ross, tested their effects on plant growth. Before joining USDA, Ross and a colleague found two radioactive elements with which they were working to be chemically identical—a finding that was an immediate forerunner to the discovery of isotopes.

Isotopic tracers have been compared in importance and character with the microscope. Versatile and sensitive, this diagnostic tool bares secrets that otherwise would be difficult to learn, if at all. Chemists, for example, use "tagged" atoms to study the degradability and fate of pesticides. Soil scientists employ isotopes to study sediment transport and the intricacies of the nitrogen cycle. Entomologists use them to unravel the mysteries of an insect's feeding, migration, and hibernation habits. Plant physiologists have a better understanding of photosynthesis and how plants use carbon to manufacture food. And animal physiologists know more about egg production, milk secretion, the physiology of reproduction, and digestion and metabolism of vitamins, minerals, and nutrients.

In the long run, the new insights that radioactive isotopes provide into the functioning of living organisms may prove most vital. For germs are no longer the prime enemy of life. Today we are more concerned about diseases—like arthritis and cancer in people and livestock—in which the organism's inner balance is upset. In these times of widespread ecological awareness, there is also concern about instability in ecosystems. To prevent these upsets, we must learn how the inner balance is maintained, whether in a healthy organism or in a life system. In this quest, atomic tracers will be one of the scientist's chief allies. Over the years, these studies will contribute greatly toward a sensitive and scientific comprehension of man and his environment. For it is the highest purpose of science to give us an understanding of consequences.

COVER: An adult rat has just undergone a surgical jugular implant through which it will be fed a standard hospital intravenous feeding solution. Researchers at the ARS Human Nutrition Laboratory are attempting to determine if hospital patients on long-term intravenous feeding develop trace element deficiencies (0575X564–21). Article begns on page 7.

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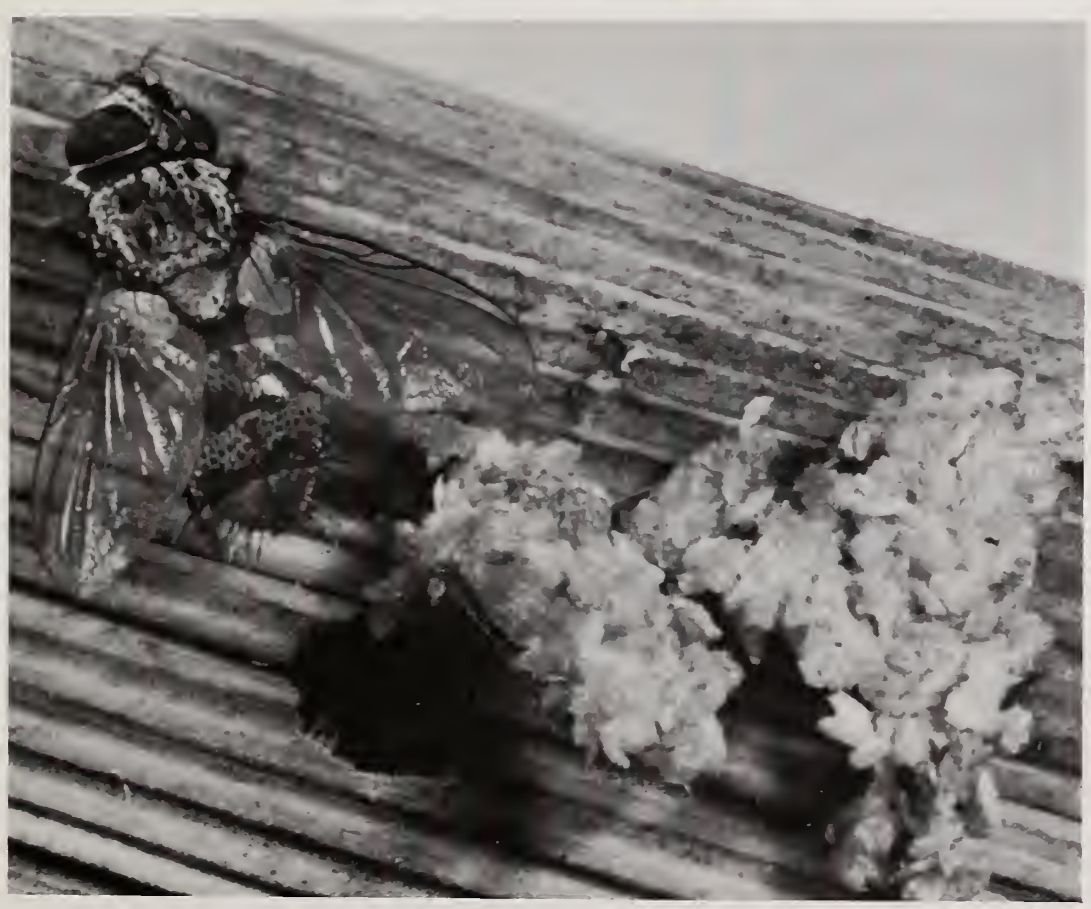


Top: A cross-section of an infested sugarcane stalk reveals a sugarcane borer larva and the enlarged exit hole it makes to accommodate the emerging moth (0874R1450–34). ***Bottom:*** *An adult Cuban fly prepares to deposit maggots in the entrance hole of a borer. The maggots will travel up the tunnel to attack the cane borer larva. The substance next to the hole is "frass," the waste material the larva pushes out while tunneling. Scientists are raising the Cuban fly as a potential biological control weapon against the sugarcane borers (0874R1453–8).*

Attacking the sugarcane borer

THE SUGARCANE BORER, *Diatraea saccharalis* (F.) literally lives to eat, and it sticks strictly to sugarcane. The borer is a widespread and costly larval menace in Louisiana, Texas, Florida, and Central and South America.

Researchers are mass-rearing and releasing a selective larval parasite—the Cuban fly—*Lixophaga diatraeae*—which may successfully infect the sweet tooth that chews the cane. Such biological control, however, depends on properly-timed releases of the fly. Phase I of the research consisted of a large-scale rearing program to provide puparia for phase II—inundative releases of the parasite into the fields.

The highly promising 18-month pilot test, coordinated by ARS entomologist Dial F. Martin at the Bioenvironmental Insect Control Laboratory, Stoneville, Miss., resulted in 900,000 puparia for use in Louisiana and Florida field studies.

At the Stoneville laboratory, host sugarcane borer larvae were reared in plastic cups, one to three larvae per cup,

Borer damaged sugarcane is compared with undamaged cane by entomologist Thomas E. Summers (0874R1450–14).

on a soybean-wheat germ diet.

To rear the Cuban fly parasite, dry, raw brown sugar was placed inside the cage to provide a food source; a jar filled with water inverted over a plexiglas plate covered with 16 by 18 inch mesh screen wire provided a water source. Adult flies—10 to 14 days after mating—were removed from the holding cages by a modified vacuum sweeper directly into a jar containing 1 percent sodium hypochlorite (NaOCl). This procedure sterilized the external surface of the flies and immobilized them for maggot extraction.

"After the flies were rinsed in distilled water, they were blended with 50 milliliters of sterile distilled water in an ordinary blender," said entomologist Edgar G. King, Jr., who headed the mass-rearing research. "The maggots were separated from fly particles by screening, then suspended in agar solution, counted, and injected into cups containing the host sugarcane larvae.

Above right: *At the Stoneville Laboratory, a vacuum tube is employed by technician Ozelle Aylor to remove flies from a holding cage prior to maggot extraction (0874R1396–8).* ***Above left:*** *Improved mass-rearing of Cuban flies is the goal of this project observed by Mississippi State University graduate student James Roth. Holes bored in the candlesticks—to simulate borer holes in sugarcane stalks—are plugged with cotton impregnated with the components of sugarcane larval excrement. The researchers are trying to isolate and synthesize the kairomone—a chemical attractant—in the excrement that causes the Cuban fly to be attracted to the larvae's holes and deposit her maggots there. Bright lights keep the Cuban flies active (0874R1398–23).*

The maggots seek out and parasitize the host larvae, feed on them, destroy them, and then leave the body and pupate. These puparia are then harvested from cups by hand and washed in 1 percent sodium hyporchlorite to reduce microbial contamination. This also destroys host larval webbing."

From 42 to 93 percent parasitization was obtained by placing the maggots on the diet instead of applying them directly on the host. Researchers built a maggot-dispensing device from an electrically-driven rotating and reciprocating pump turned on by the operator through a foot-operated switch. The new device dispensed single drops of agar solution containing the maggots, and was 30 times as fast as the manual method of infesting the host larvae.

For shipping, puparia were packed in 30-milliliter cups—100 per cup—between layers of lightweight water-absorbent material in biomailers, and shipped by air freight for field release to the Sugarcane Field Station, Canal Point, Fla., and the U.S. Sugarcane Laboratory, Houma, La.

At Canal Point, the Stoneville-reared puparia were placed in mating cages. The emerged adults were watered, fed, and maintained in the laboratory from 4 to 7 days prior to being taken into the field and released in pilot tests. In evaluating the test, the position of borers by the parasite was recorded weekly, and the damage to the cane was determined at harvest time.

Beginning in August 1973, the first of two release sites received 150 adult parasites per week per acre at four weekly intervals in August and September, a total of 600 per acre. The 40-acre area was monitored weekly for number of borers and the percentage of parasitism until November, when the sugarcane was harvested. Parasitism reached 52 percent in September and was 27 percent at harvest time. In October there were only 1,323 healthy borers in the release site compared to 5,100 healthy borers, 1,600 feet away from the site.

The second release site did not receive parasites until October 15, when one single release of 550 adults per acre was made.

Parasitism of sugarcane borers by the Cuban fly reached a high of 65 percent in November and 61 percent in December when the experiment was terminated by harvest.

In the 1974 pilot test at Canal Point, researchers released 600 parasites per acre into a 100-acre block of borer-infested sugarcane. The 60,000 parasites were divided into four separate releases of 150 per acre on June 6, 14, 17, and 26. On June 26, parasitism reached 78 percent.

"It is interesting that the highest recorded degree of parasitism—100 percent—occurred at 1,700 and 2,400 feet from the release site on November 16. This was just prior to a freeze and, of course, the end of borer and parasite activity for the year," said entomologist Thomas E. Summers, who headed the phase II research in Florida.

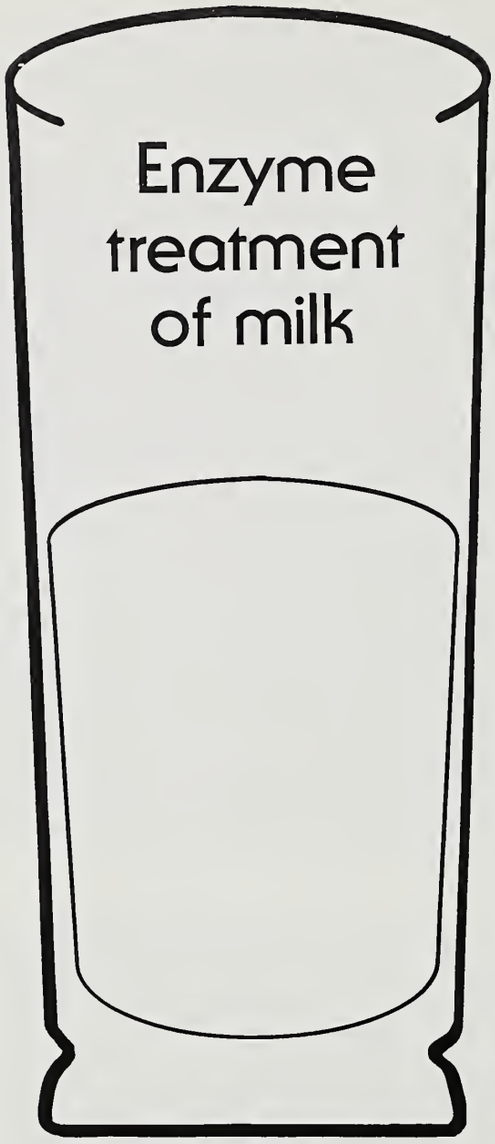
Also, significantly fewer damaged internodes were observed in the area of release than in the adjacent control areas where there was no parasite release. In the release area the "bored" or damaged internodes averaged 5.7 percent at harvest while up to 33 percent damaged internodes were found in the control areas.

In addition to Dr. Martin and Dr. King, the Stoneville research team included agricultural engineer Charles W. Gantt and biological technicians Lavenia R. Miles and Glynn G. Hartley. Agricultural technician Griffin Bell assisted in the field release and evaluation at Canal Point.

Results from parasite releases into sugarcane fields at Houma, La., were not conclusive for 1974, according to entomologist Robert D. Jackson, but further evaluation at Houma, Stoneville, and Canal Point continues. □

***Left:** At Canal Point, Fla., emerging adult Cuban flies are fed a diet of raw sugar and water by technician William Brancati (0874R1449–10A). **Above:** After a few days on the sugar diet, the flies are released in nearby borer-infested fields by technician Griffin Bell. Future large-scale parasitic releases will be made from aircraft (0874R1451–10).*

Enzyme treatment of milk



TREATING MILK with the enzyme lactase may give it a greater potential for making improved dairy products.

Lactase treatment increases the sweetness of milk, reduces the tendency of some dairy products to crystallize, facilitates fermentation with culture organisms, and makes milk more digestible by lactose-intolerant people.

The enzyme makes milk sweeter because it breaks down, or hydrolyzes, the milk sugar lactose into glucose and galactose. These are sweeter and much more soluble sugars than lactose.

The lactase used for such treatment is obtained from the yeast *Saccharomyces lactis*. Treating milk with lactase is relatively simple, but the enzyme is expensive. New, cheaper grades of lactase are now becoming available, however.

ARS scientists at the Eastern Regional Research Center, Philadelphia, Pa., are working simultaneously on two fronts: devising cheaper and more efficient ways of hydrolyzing lactose, such as immobilizing the enzyme to permit its repeated use (AGR. RES., June 1973, p. 3) and, in anticipation of success in this area, making experimental products with lactase-treated milk. The scientists involved include chemists John H. Woychik, Virginia H. Holsinger, Virginia S. O'Leary, Arjen Tamsma, and Marvin P. Thompson, and food technologist Eugene J. Guy.

The difficulty some people have in digesting lactose was what started research on lactase treatment. These lactose-intolerant individuals—mostly non-Caucasians—are deficient in lactase. If, in the milk and other dairy products they consume, there is more lactose than their system can hydrolyze into digestible glucose and galactose, they may suffer abdominal pains, flatulence, bloating, or diarrhea. Treatment with lactase from a nonhuman source to hydrolyze the lactose makes milk digestible by the lactose-intolerant.

Except for the added sweetness, lactase treatment does not affect milk's flavor. Taste panelists cannot tell lactase-treated milk from milk with sucrose added. In one test at Johns Hopkins University with 27 adolescent blacks, most detected the added sweetness of the treated milk, but all except one liked it.

The extra sweetness has some obvious advantages. When used to make products like ice cream, the treated milk requires less sucrose—in these days of high sugar prices, an economic as well as a nutritional advantage.

Setting out to exploit the advantages of lactase treatment, ARS scientists began with whey, the watery byproduct of cheesemaking, whose total solids consist of 70 percent lactose. The hope was that the treatment would provide urgently needed additional outlets for accumulating surpluses of whey.

The enzyme treatment opens new possibilities for the use of whey because it reduces the tendency of lactose to crystallize. Thus high-solids sirups that should have many food applications can be made from treated whey. And if even high-solids whey sirups do not crystallize, the treated whey could certainly be used in ice cream formulas. This would be a natural way of preventing sandiness in ice cream (instead of by use of stabilizers).

Experiments in making cheese with lactase-treated milk, just now getting underway, suggest that the best time to hydrolyze lactose may be before the cheese is made, not after the lactose emerges in the byproduct whey. In preliminary tests, the experimental cheese ripened faster with no quality loss. And in making another cultured product, yogurt, glucose in the treated milk speeded up acid production by the culture organisms. Also, the sweeter yogurts made from the treated milk were overwhelmingly preferred by a consumer-type test panel.

Improved frozen 3 to 1 milk concentrates can also be made from lactase-treated milk. If processed with a little extra heat treatment, these concentrates will keep at least 9 months without significant change in viscosity. ARS researchers have long sought a way to prevent this highly desirable product from gelling in storage.

Lactase-treated milk, both whole and skim, can also be dried to a powder. There is some difficulty in drying the skim milk because of its tendency to stick to the surfaces of the dryer. It can be done, however, if the powder-collecting apparatus of the dryer is kept from getting too hot and the powder is rapidly cooled after drying to avoid clumping.

The promise of lactase-treated milk to provide a whole family of dairy products seems to fully justify the intensive efforts being made to bring it to commercial reality. □

Adult rats raised on zinc-deficient diets exhibit a higher degree of aggression when they receive electric shocks than pairs of rats fed nutritionally balanced diets. Aggressive behavior of rats like the pair in the photo is video taped with sound to allow close analysis of their behavior. Scientists are attempting to correlate behavior and brain chemistry in these zinc-deficient rats. These and other studies at the Human Nutrition Laboratory, Grand Forks, N. Dak., may lead scientists to discoveries of the roles of trace elements in human nutrition (0575X567–25).

Human Nutrition: Probing the trace elements

EXPLORING THE INTRICACIES of nutrition in man and animals is a challenge that ARS scientists are meeting with new insights gained at the Human Nutrition Laboratory, established only 5 years ago at Grand Forks, N. Dak.

There, researchers study trace elements, so-called because they are present in the body in minute amounts. Trace elements help sustain life and promote growth. Increasing knowledge about these elements and the roles they play bear directly on human health.

"The amounts of trace elements that nutritionists recommend for human diets are based, in some cases, on observations in animals and educated guesses," says Dr. Harold H. Sandstead, Director of the Laboratory. "We're seeking more specific information on dietary needs and how these needs can be met."

The Human Nutrition Laboratory is unusual as a national public research facility because its main focus is on the nutrition of persons in normal health. Dedicated in 1970, the laboratory is still being staffed for research to be conducted in its human metabolic unit.

Meanwhile, the scientists are gaining insights through their work with laboratory animals and through collaborative and cooperative studies with medical schools. For example, more than one-fourth of the laboratory's annual $1 million budget currently supports cooperative research with the University of North Dakota School of Medicine.

The laboratory itself is on the university campus.

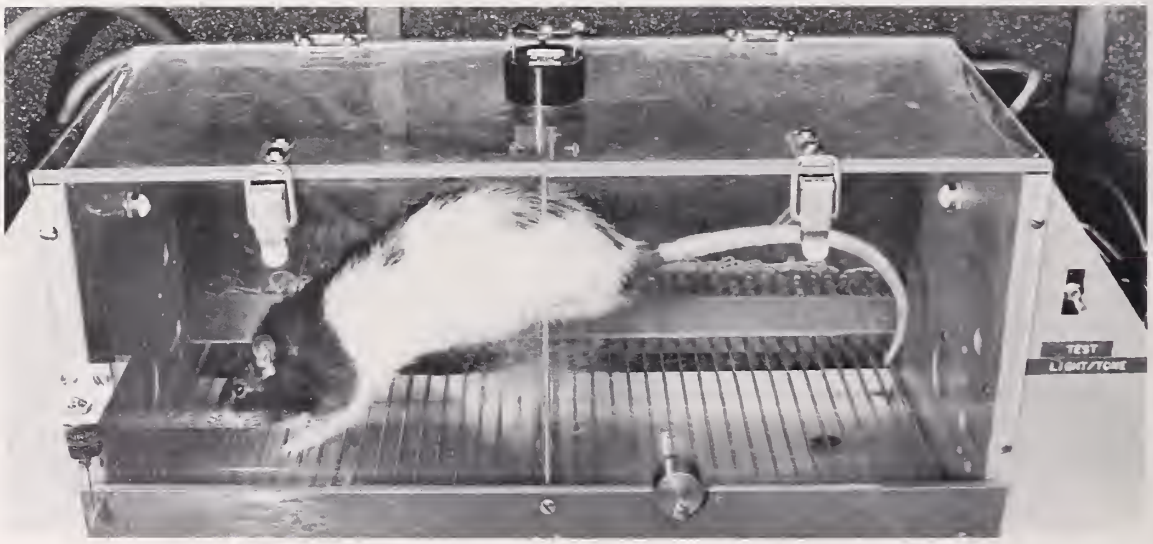
Already, the ARS researchers have reached several milestones.

Availability of zinc, copper.— Chemist Gary W. Evans and biochemist Carole J. Hahn made discoveries that may eventually lead to improvements in the biological availability of zinc and copper in foods. The scientists found that digestive juice from the pancreas of dogs and rats contains a constituent which combines with zinc in the small intestine and facilitates the uptake of zinc by intestinal cells. The researchers also identified a protein in the intestine which facilities uptake of copper.

"When humans or animals suffer from a trace element deficiency, simply supplementing the diet may not neces-

Left: *In preparations for a neurotransmitter assay to analyze the brain chemistry, University of North Dakota chemist Gail M. Reynolds prepares a brain homogenate using brains taken from zinc-deficient rats immediately after their final aggression tests. Researchers are hopeful of correlating neurotransmitter levels with aggression levels (0575X572–3).*

Below: *An adult rat, whose dam was fed a zinc-deficient diet during gestation, scrambles over the divider in a shuttle box during a learning experiment. The learning ability of zinc-deficient rats is slower than that of rats on normal diets (0575X569–23).*



sarily be the best measure to take," says Dr. Evans. Without a thorough knowledge of the absorption mechanisms, one could find supplementation ineffective.

Since many trace elements interact in the intestines, an understanding of the absorption process could help in preventing a deficiency of one element while attempts are made to supplement the diet with another element, Dr. Evans says.

Zinc and learning.—In other research, scientists are studying the roles of zinc after it is absorbed in the body. Dr. Sandstead, biochemist Gary J. Fosmire, and psychologist Edward S. Halas showed that zinc deficiency adversely affects brain growth, learning ability, and aggressiveness of rats (AGR. RES., Mar. 1975, p. 11).

If these findings relate also to man, they may have profound social implications. This concern has prompted studies on pregnant women to assess the role of zinc in human pregnancy. Other studies with laboratory animals may provide new insights on the biochemistry of learning.

Zinc-copper and heart disease.—New insights on coronary heart disease are emerging from research led by medical officer Leslie M. Klevay. In laboratory rats, he found that cholesterol levels in blood plasma rise as the animals are fed a diet high in zinc relative to the amount of copper (AGR. RES., Aug. 1974, p. 10).

Humans with high levels of cholesterol in their blood are more likely to have heart attacks than persons with low cholesterol levels, studies over the years by other researchers have shown.

Dr. Klevay says that the amounts of zinc and copper in a person's body may be related to several situations that other researches have suggested as causes of heart disease. These include consumption of soft water, high consumption of sucrose, low consumption of vegetable fiber, and lack of exercise. Excessive vitamin C intake may also be implicated.

Recent research suggests that persons who try to decrease the risk of the common cold by taking doses of vitamin C that are several times the daily recommended allowance may increase their risk of coronary heart disease.

Dr. Klevay found that rats fed high amounts of vitamin C (ascorbic acid) developed high concentrations of cholesterol in their blood plasma compared with those fed the same diet without

***Below:** Mealtime is exciting for hungry rats despite the high arsenic diet being fed them by research assistant Cosette M. Hemen for another of the trace element studies (0575X560–33). **Right:** Research technician Thomas W. Winter performs surgical cannulation of the jugular vein to implant the tubing shown on the cover. When the implant is in place, the rat will live in a relatively unrestricted condition. It will be fed a standard hospital intravenous solution through the tubing at a rate of 60 milliliters per day for 5–10 days (0575X564–13).*

Right: Research assistant Pat A. Swangler weighs young rats being raised on zinc-deficient diets. The rats are weighed daily and their growth rate compared to rats on normal diets (0575X559–14). ***Below:*** *Human red blood cells, taken from volunteers in the human metabolic laboratory, are poured into a digital clinical analizer to make a statistical survey relating vitamin B_2 and B_6 deficiencies to specific diseases (0575X 601–5).*

ascorbic acid. Ascorbic acid decreases the amount of copper that can be absorbed from food, says Dr. Klevay. A consequent imbalance of zinc and copper metabolism may increase cholesterol levels in the blood.

Dr. Klevay also points to findings in epidemiological and clinical studies that show a dietary imbalance of zinc and copper may increase the risk of heart disease in humans.

Researchers have differing opinions on whether large amounts of Vitamin C are useful in prevention of and effective in decreasing the frequency and severity of respiratory infections.

Nickel is essential.—Scientists at the Human Nutrition Laboratory also discovered that nickel plays an essential physiological role in some laboratory animals. Biochemist Forrest H. Neilsen and Dr. Dwayne Ollerich, professor of anatomy at the University of North Dakota, found that the livers of chicks and rats were adversely affected by diets that contained too little nickel—three to four parts per billion (AGR. RES., Dec. 1973, p. 5).

Even with diets this low in nickel, the researchers brought out the effects of deprivation in rats only by feeding the diet to successive generations. In their studies with both chicks and rats, they took precautions to insure that the animals did not get nickel from such sources as caging, feed cups, water bottles, dust in the air, and skin of investigators' hands.

As far as human nutrition is concerned, it is premature to predict the impact these studies on nickel may have, Dr. Nielsen says. Further research may delineate the role of nickel in nutritional diseases caused by diets inadequate in other nutrients.

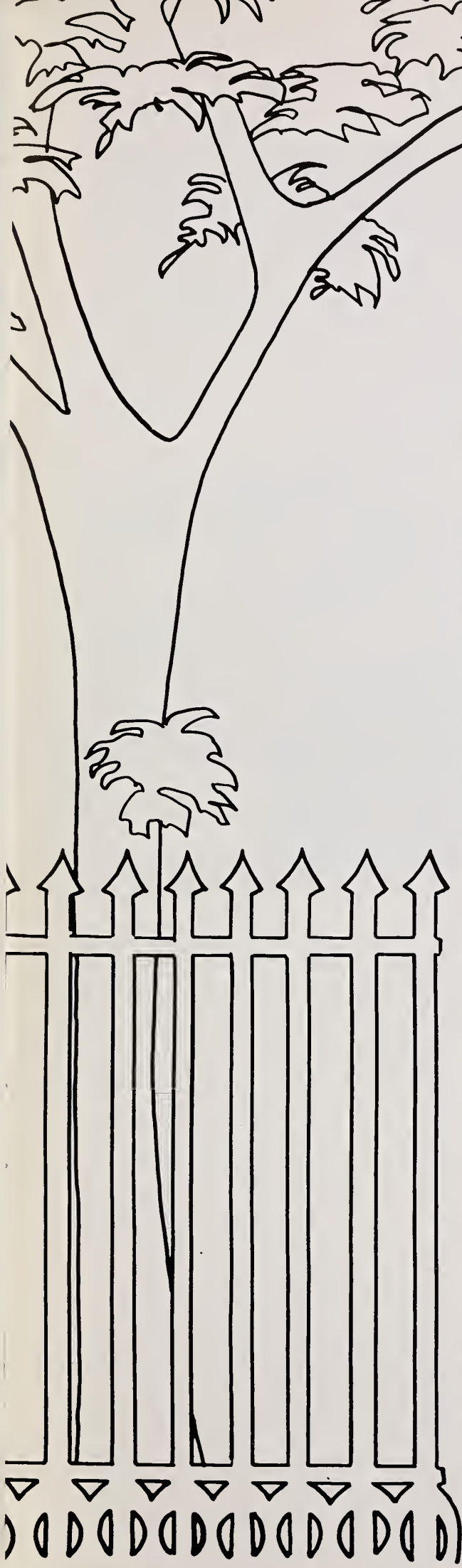
Enzymes and elements.—While continuing to study metabolic and physiologic roles of nickel, Dr. Nielsen is evaluating conditions that may influence dietary requirements. Similarly, he is studying two other trace elements which, like nickel, he considers abstruse. They are vanadium and arsenic.

Because of complexity in nutritional processes, the scientists do not limit their quest for knowledge exclusively to trace elements. Chemist Kim P. Vo-Khactu conducted studies to learn whether simultaneous deficiencies of thiamin and riboflavin (vitamins B_1 and B_2) interfere with assessing the deficiency of either vitamin.

Dr. Khactu conducted the research in the laboratory's clinical chemistry unit where she was supervisor. The unit closely monitors studies conducted with human volunteers. With the opening of the metabolic unit, some of the volunteers will be confined to the laboratory where they will eat carefully regulated diets.

Research equipment which will be used in the human nutrition studies includes a whole-body counter, which monitors naturally occurring radioactive isotopes in volunteers who have consumed foods containing them.

The metabolic studies will prove valuable as the ARS nutrition scientists collaborate with soil scentists, agronomists, food technologists, and engineers. The sharing of knowledge may lead to changes in farm technology and development of new highly nutritious foods from cheaper raw products than are now used. □



No flies in this zoo

ZOOLOGICAL PARKS may become more pleasant places for kids of all ages to visit and more pleasant places for animals to live as a result of research with what may be the world's largest laboratory animal.

The zoological parks at some 200 localities in this country are generally within the boundaries of municipalities. Consequently, the insect problems associated with the more than 40,000 confined animals can also become an insect problem for the surrounding communities.

As a first step toward better control of the insect problem, a multi-disciplinary team of ARS scientists has successfully controlled dung-breeding house flies and stable flies by incorporating an insect growth regulator (IGR) in the diets of rhinoceroses. Team members are entomologist James E. Wright, chemist Delbert D. Oehler, and veterinarian James H. Johnson.

Working with officials of Lion Country Safari, Inc., Grande Prairie, Tex., located between Dallas and Fort Worth, the scientists were able to achieve 100 percent control over both house fly and stable fly larvae.

Although good sanitation procedures and insecticides are usually employed judiciously for fly control, zoo keepers, and the surrounding communities, would welcome an easier, more efficient method for controlling flies. Including an IGR in all animal diets may prove just the solution needed.

The IGR, an experimental commercial product known as TH 6040, was incorporated in extruded feed pellets at the rate of 243.2 grams of active ingredients per ton, a dose that would provide a daily intake of approximately 1 milligram per kilogram of body weight by each of 19 white rhinoceroses, when fed 200 pounds per day.

The animals were fed at that rate for 60 days. During that period feces were inoculated with both house fly and stable fly eggs. Beginning 5 days into the feeding program and for 5 days after the 60 day test, no larvae emerged into adulthood.

A second test, incorporating only 0.1 mg/kg of body weight of the chemical, was conducted for 40 days with identical results—total control.

In addition to the laboratory inoculations, continuing checks were made of feces left in the open in the rhinoceros area and no flies were found during either test.

The rhinoceroses readily ate the treated feed at both dosage levels and displayed no dietary avoidance throughout the tests. Moreover, no clinical signs of toxicity from the chemical were noted in either test in any of the 19 test animals.

The same approach to fly control may be feasible with other dung-producing animals, although a careful screening would be necessary to determine if any of the animals might prove sensitive to any toxic properties the chemical may have and that have not yet been elucidated. □

This close-up of a leafcutter bee cell shows the deadly way of the parasitic wasp, Sapyga pumila. *Two wasp eggs lie near a larger bee egg, which floats in its pool of pollen and nectar. A third parasite in larval stage is already attacking the bee egg. The* Sapyga *wasp enters the cell by puncturing the protective leaf cell cap with her ovipositor (PN–2891).*

Keeping leafcutter bees in business

CONTROL of an important parasitic wasp, *Sapyga pumila,* can now be effectively achieved in any leafcutting bee operation thanks to a new technique.

The protein-rich hay and forage crop, alfalfa, can only be pollinated by insects. Alfalfa leafcutter bees are among the best of the alfalfa pollinators, but in recent years they have suffered great losses in the West because of *Sapyga* wasps. Consequently, the alfalfa seed crop has suffered too.

Sapyga wasps deposit their eggs in leafcutter bee cells. Wasp larvae hatch, destroy host eggs, consume bee provisions, damage bee nests, and diminish the chances of bee survival. In addition, the feeding habits of the wasp larvae attract flour and carpet beetles, notorious destroyers of bee nests.

ARS entomologist Philip F. Torchio, Bee Biology and Systematics Labora-

Right: Entomologist Franklin Parker examines leaves of a native shrub which are used by the leafcutter bees for nesting material. The bees cut long leaf sections for the sides of their nests—or cells—and round pieces for the closing caps (0774X1170–10A). Below: Dr. Torchio examines parasites that have been drowned in a tray of oil as they emerged from the bee nests (PN–4101).

tory, Logan, Utah, developed the control technique.

In 2 years his technique reduced the rate of wasp parasitism in a commercial leafcutter bee operation from 74 percent of the cells prior to controls, to 40 percent after the first year, to only 3 percent after the second year of control. Over 800,000 wasps, representing a potential $100,000 loss to the grower in cost of bees and reduced pollination, were captured during this period.

Wasps and bees emerge from the nests at approximately the same time. Mr. Torchio designed an emergence trap to control the wasps as they first emerge from their host nests—before they can cause any further damage or lay any more eggs.

The emergence trap consists of a box in which an ultraviolet light is placed behind a front glass pane that is elevated one-sixteenth of an inch above the floor of the box. The black light attracts insects and the narrow space allows only the wasps to enter the trap. A petroleum gel is smeared on the floor of the box in front of the black light, and two rectangular trays, partially filled with used crankcase oil, are fitted onto the floor between the glass pane and the black lamp. Wasps entering the trap are either embedded in the petroleum gel or drowned in the trays of oil.

Mr. Torchio augments his emergence traps with two other types: mating station and night station traps. Mating station traps employ petroleum gel to capture female wasps who must land on the station's surface for mating to occur. Stations are easily located because the male wasps swarm above the mating sites for several hours each day.

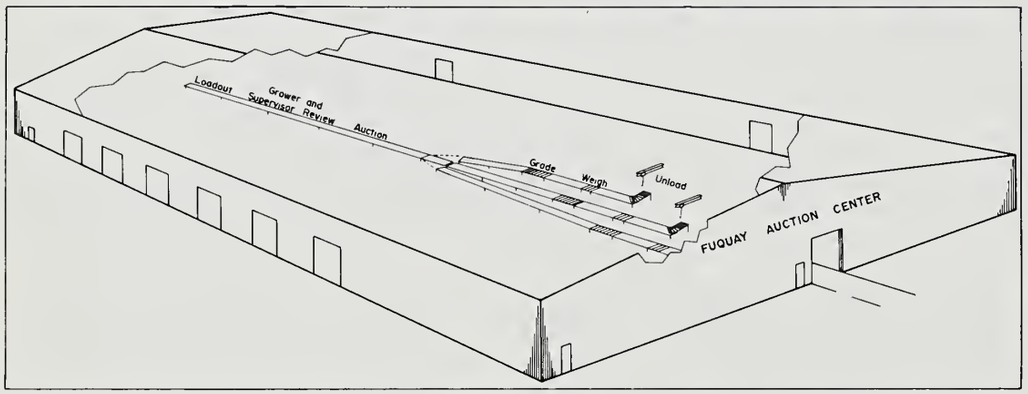
Night station traps—unlike the emergence and mating station traps which capture wasps before they visit host nests and deposit eggs—capture wasps during their parasitic activities and thus can be considered last lines of defense.

Night station traps are wood blocks which are placed in wasp nesting shelters. The blocks contain one-tenth-inch diameter holes filled with petroleum gel. Wasps find the tiny holes attractive places to spend the night and, on doing so, become stuck.

Night station traps are the only method currently known for controlling wasps that migrate into an area during the last half of the flight season. When these traps are used in conjunction with the other two, more effective, earlier-striking traps, odds against the *Sapyga* wasps become insurmountable. □

Selling Tobacco:

In and Out in 30 Minutes



A diagram of the Fuquay Auction Center (PN–4102) and the photo of tobacco inspection and bidding during an auction (PN–4103) depict the efficiency of the newly developed system. Growers can deliver their tobacco; have it weighed, graded, and sold; and be on their way home with a check in their hands in 30 minutes.

"I'VE seen trucks sitting over there waiting a week to unload. It was ridiculous!"

That's how ARS industrial engineer Al Graves responded to the sight of growers lined up outside a tobacco auction warehouse in the seemingly endless wait to get their tobacco sold.

For years in the northern flue-cured areas, tobacco has been tied in "hands," packed in baskets, placed on handtrucks, pushed to the scale for weighing, then pushed by hand to the sales floor. In southern flue-cured areas, untied "looseleaf" tobacco has been placed in baskets in sheets, then handled in the same way as northern flue-cured. Increasingly scarce and expensive labor supplies make the labor-extensive sales method impractical.

In 1967 Mr. Graves designed an improved receiving system at tobacco warehouses that would reduce the labor needed and increase the receiving rate of presheeted tobacco.

During the 1968 marketing season, about 50 receiving systems were used to move sheets of untied tobacco in baskets—built up to 200 pounds—from the growers' trucks to the sales floor.

With some variations because of individual differences in physical layouts, each receiving system consisted of gravity roller conveyor sections extending from the grower's truck across the scale to an unloading point. There, a forklift, with a 12-foot section of conveyor attached to the forks, took the sheets across the warehouse floor to their selling position.

Conveyor sections were sloped so that baskets would start by themselves with gravity and move unassisted from the conveyor line to the final forklift. Tests showed that the receiving system could operate at the design rate of 3 baskets a minute, but in practice the average rate was 2.5 baskets a minute. This compares to about 1 basket per minute under old systems.

Some warehousemen were able to receive all tobacco for a sale during one work shift and some stated that their labor cost was reduced about 50 percent from the normal cost of flooring tobacco using manual labor and hand trucks.

During the 1969 and 1970 marketing seasons, Mr. Graves performed full-scale tests of a complement to the mechanized receiving system—a system of scheduling the arrival of tobacco at warehouses.

The scheduling system involves setting up appointments for arrival at the warehouse shortly before the market opens. The schedule is confirmed by the grower on a weekly basis as the season progresses. Total potential savings to tobacco growers and warehousemen in the flue-cured area as a result of scheduling tobacco at the warehouse are estimated at several million dollars annually.

Next, a system was designed for the mechanized removal of sheets of untied tobacco from the warehouse sales floor. In the past, it took hand labor to lift sheets of tobacco onto hand trucks or jacks (square frames with casters under each corner) and move them from the auction sales floor to company load out areas. It usually took a crew of 18 to 20 men, wandering around the floor with different company's jacks in

hand, looking for the right sheets to load. In the new system, sheets are lifted mechanically, carried to a distribution area, and placed on jacks at the end of a gravity conveyor.

The full-scale test of this system took place during the 1971 marketing season. The main piece of equipment is called a "sale breaker" and consists of a standard forklift with two powered belt conveyors supported by a frame attached to the forks of the truck. This unit was used to move sheets of untied flue-cured tobacco from the auction warehouse sales floor to a jacking station where the sheets were placed on a pair of inclined gravity roller conveyors, pulled to the end of the conveyor and stacked, two high, on jacks.

The seven men required to operate the sale breaking system for a normal size operation cost 23 cents per 1,000 pounds at a labor cost of $2 an hour. Equipment cost was figured at 16 cents per 1,000 pounds, for a combined cost of 39 cents—a reduction of about 50 percent of the present cost.

Mr. Graves didn't stop. He had spent 8 years designing and testing systems of gravity and motor-driven conveyor belts, forklifts, and scheduling that represented the first major change in the flue-cured tobacco auction warehouse operations in nearly a century.

For the 1974 tobacco marketing season the entire mechanized tobacco sales system got a full-scale performance test in the Fuquay Auction Center at Five Points Warehouse, Fuquay-Varina, N.C., about 15 miles southwest of Raleigh, N.C.

With this system, the grower could arrive at the warehouse at a specific time, have his tobacco unloaded, weighed, and graded, observe his tobacco sold at auction, get his check and leave the warehouse within 30 minutes.

The closest thing to a complaint came from one grower who said that by the time his truck was unloaded and he had driven around to the parking area, his tobacco had gone through the line, been graded, and sold and he didn't even get a chance to see it happen! □

AGRISEARCH NOTES

Pathogen attacks spurred anoda

SPURRED ANODA (*Anoda cristata*) is a very troublesome weed rapidly spreading in cotton and soybean fields throughout the Mississippi-Yazoo Delta. Now two naturally occurring plant pathogens tentatively identified as *Puccinia heterospora*, and an *Alternaria* species—or a combination of the two fungi—may provide biological control agents for the weed.

Found over a widespread area, the diseases affect large numbers of spurred anoda plants. Symptoms ranged from a few typical *Alternaria* lesions or rust pustules to severe defoliation and death of the plants. In fields where spurred anoda plants were heavily infested, surviving plants could not be found.

Comparing data from fungi-infected weeds and healthy plants, researchers found that the two organisms practically eliminated spurred anoda's seed production. Combined, the two diseases reduced seed production more than 99.9 percent. The pathogens also stunted the growth of the spurred anoda, reducing the weeds 94 percent in dry weight and 58 percent in height.

In greenhouse studies, the *Alternaria* species killed inoculated spurred anoda plants.

"Additional research is needed to overcome difficulties of spore production, because this species of *Alternaria* does not sporulate well in culture," said ARS plant pathologist Howard D. Ohr, Southern Weed Science Laboratory, Stoneville, Miss. "But this pathogen may be promising as a potential 'herbicide' if further testing demonstrates it to be be host specific."

Dr. Ohr, ARS agronomist James M. Chandler, and plant physiologist Thomas N. Jordan at the Mississippi Agricultural and Forestry Experiment Station, Stoneville, Miss., cooperated in the initial investigations.

The troublesome weed, spurred anoda, is under attack by scientists with pathogenic agents that may help eliminate the costly weed from many areas of the south (PN–4104).

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Hail protection on fallow land

KEEPING at least a 50-percent mulch cover on fallow land can substantially reduce soil erosion caused by hail on the Great Plains.

This protection is particularly needed in the principal hail belt, extending from north Texas to western North Dakota, where nearly half of the cropland is fallowed each year.

ARS agricultural engineer Lawrence J. Hagen found that hail striking at low energy, about 3.6 foot-pounds per square foot, can increase soil detachment from clods by 50 percent over no hail. He says this energy level is common in a high percentage of Great Plains thunderstorms accompanied by hail. Soil loss can be doubled if hail energy is 36 foot-pounds per square foot.

In laboratory experiments in a rain-tower-wind tunnel facility, Mr. Hagen found that increased soil detachment occurs when hailstone diameter exceeds 0.75 centimeters (slightly more than one-fourth inch). Smaller hailstones may slightly damage clods, but they quickly cover the surface as a mulch to protect the soil during subsequent rain.

Mr. Hagen and agricultural engineers Leon Lyles and Jerry D. Dickerson, in cooperation with the Kansas Agricultural Experiment Station, Manhattan, found that hail size and energy, windspeed, and surface cover—and interactions between them—all influence soil loss from clods.

In the study, Mr. Hagen simulated hailstones one-fifth inch in diameter with tapioca and those a third and two-thirds of an inch in diameter with marbles. Weighed amounts of simulated hail were dropped at energies calculated to approximate those reported in nature.

The engineers measured soil loss from clods about 0.4 to 1.5 inch in diameter with no mulch and a 50- or 90-percent cover of wheat straw. Each test simulated a typical plains storm—10 minutes of rain, hail, and an additional 20 minutes of rain. Tests were run with and without wind.

New textile analytical technique

WHEN DEVELOPING flame retardant, durable press, or other special chemical finishes for cotton and cotton/polyester blend fabrics, scientists know where within or on the fibers they want the chemicals to be located. However, for lack of a good analytical technique they have always been forced to assume the location and distribution of the chemicals by fabric performance, a somewhat subjective determination.

Now, thanks to a new technique developed at the Southern Regional Research Center, New Orleans, La., by chemists Wilton R. Goynes and Linda Muller, physical science technician Jarrell H. Carra, and textile technologist Ines deGruy, the scientists can "see" where the chemicals are located and how they are distributed.

The new technique employs a combination of scanning electron microscopy and energy dispersive x-ray analysis.

The procedure involves viewing thick fiber sections (5 to 15 micrometers) in the scanning electron microscope, making electron micrographs of the area of interest, then making an x-ray distribution image. Correlating the micrograph with the x-ray distribution image allows the scientists to determine just where the chemicals are deposited.

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